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(54) **EMERGENCY SAFETY SWITCH**

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- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 722 days.

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(57) **ABSTRACT**

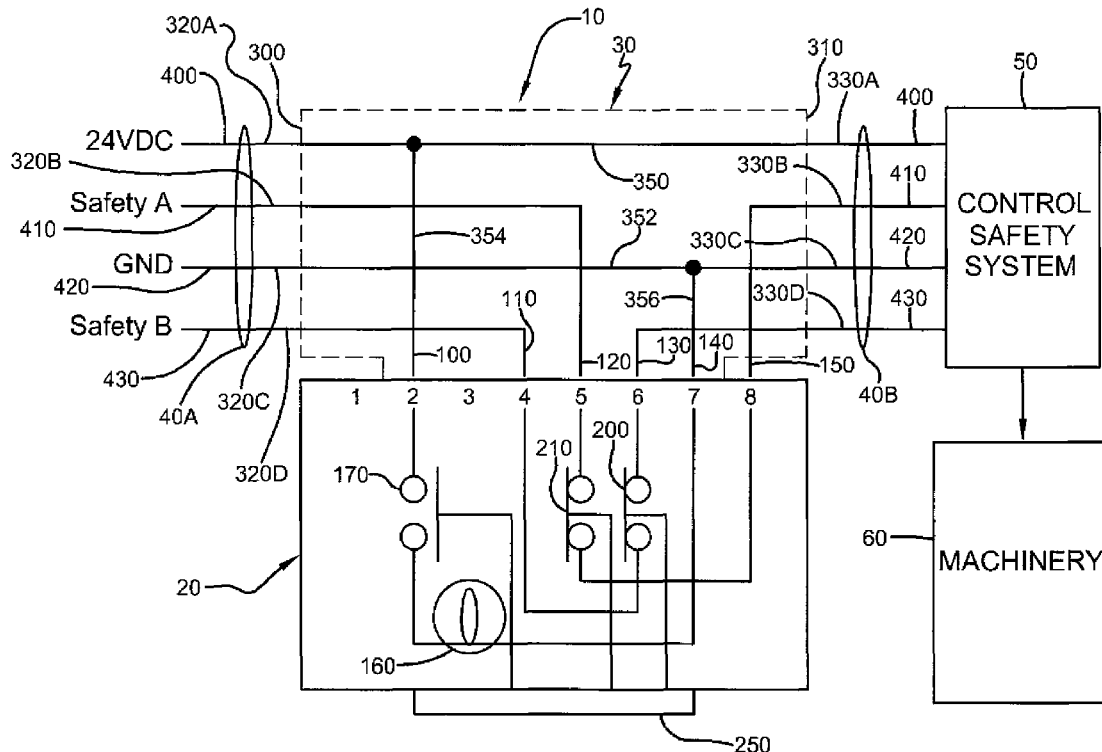
An emergency safety switch for a safety control system used to terminate the operation of one or more automated machines includes a stop circuit that is electrically connected to a connection port. The connection port includes a pair of interface ports for in-line serial connection to a wiring circuit provided by the safety control system to monitor various emergency safety switch and other detection devices. As such, the connection port provides a quick and easy manner for attaching and detaching the emergency safety switch to the wiring circuit, which facilitates efforts to install a sufficient number of emergency stop switches on an automated production line.

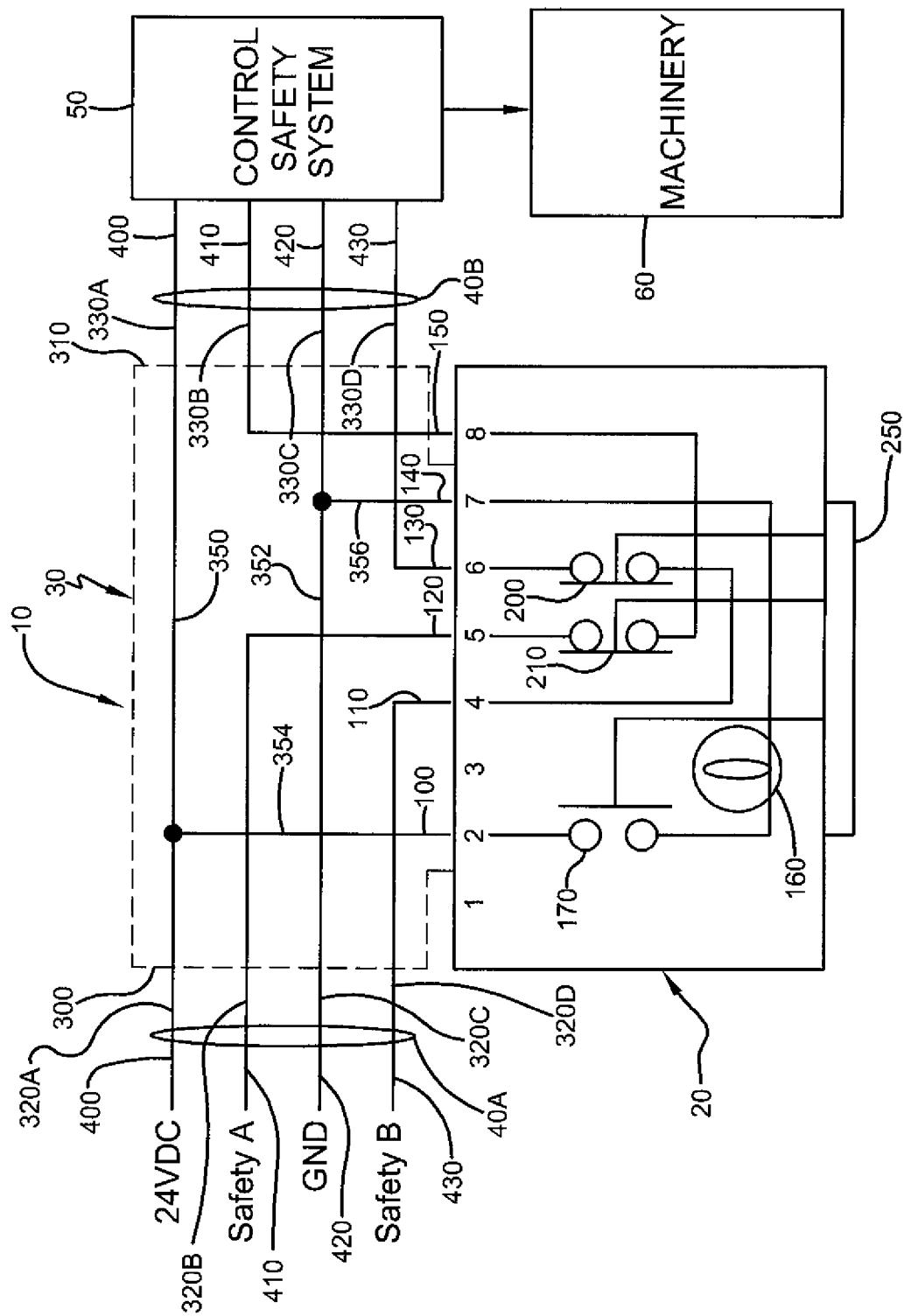
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4 Claims, 1 Drawing Sheet





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EMERGENCY SAFETY SWITCH**TECHNICAL FIELD**

The present invention relates generally to an emergency safety switch for automated machinery. More particularly, the present invention relates to an emergency safety switch configured for use with existing safety circuit wiring provided by a safety control system. More specifically, the present invention relates to an emergency safety switch having a connection port to facilitate the attachment of the emergency safety switch to existing safety circuit wiring provided by a safety control system.

BACKGROUND ART

Emergency safety switches, emergency stops, or E-stops are typically part of a comprehensive safety control system that is utilized to supervise the operation of automated production systems, such as those used, for example, for automated manufacturing. Specifically, the safety control system is in communication with one or more emergency safety switches and with various pieces of automated machinery that is part of the automated production line. In response to the actuation of the emergency safety switch to indicate that an unsafe event has occurred or is about to occur, the safety control system stops or terminates the operation of the automated machinery in order to prevent the occurrence of injury to workers, the machinery, or to the articles being handled by the machinery. Thus, emergency safety switches or E-stops are provided as manually-actuated switches, which are actuated by a worker when he or she identifies or anticipates an unsafe condition and needs to stop the automated movement of the production line machinery.

Current emergency stop switches or E-stop switches are required to be hardwired into the safety circuit wiring of the safety control system, which requires substantial time and effort to carry out. In the case of existing safety control systems that utilize proprietary wiring configurations, it can take an inexperienced technician a significant amount of time and effort to understand the wiring logic of such wiring configurations in order to correctly attach the emergency safety switch or E-stop to the safety system wiring. Such drawbacks may result in the lack of a sufficient number of emergency safety switches or E-stops being installed along the automated production line or, in some cases, the complete lack of the installation of any emergency safety switches altogether.

Therefore, there is a need for an emergency safety switch, or E-stop, that is configured to be easily retrofit or attached to the wiring of an existing safety control system for the machinery of an automated production line or process. In addition, there is a need for an emergency safety switch, or E-stop, that is low cost.

SUMMARY OF INVENTION

It is thus an object of one aspect of the present invention to provide an emergency safety switch that can easily be coupled to a safety control system for machinery in a production line.

It is an object of another aspect of the present invention to provide an emergency safety switch, as above, that can economically be retrofit to existing safety control systems.

These and other objects of the present invention, as well as the advantages thereof over existing prior art forms, which

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will become apparent from the description to follow, are accomplished by the improvements hereinafter described and claimed.

In general, an emergency safety switch configured to be coupled to a wiring circuit of a safety control system used to terminate the operation of one or more automated machines coupled thereto includes a first path having a first control switch. The emergency safety switch also includes a second path having a second control switch, and a main switch that is in operative communication with the first and second control switches. A first and second connection interface is adapted to be coupled in series with the wiring circuit of the safety control system. Each connection interface has at least four terminals, such that the first and third terminals of the first and second connection interfaces are coupled together by respective first and second bridge lines. As such, the first path is coupled between the fourth terminals of the first and second connection interfaces, and the second path is coupled between the second terminals of the first and second connection interfaces. Thus, when the main switch is actuated, the control switches are moved from a normally closed state to an open state.

A preferred exemplary emergency safety switch for a safety control system made according to the concepts of the present invention is shown by way of example in the accompanying drawing without attempting to show all the various forms and modifications in which the invention might be embodied, the invention being measured by the appended claims and not by the details of the specification.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic view of an emergency safety switch, or E-stop switch, in accordance with the concepts of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

An emergency safety switch is generally referred to by the numeral **10** in the drawing. It should be appreciated, that the term “emergency safety switch” may be used herein interchangeably with the terms “E-stop” and “emergency stop switch”. Specifically, the emergency safety switch **10** includes a stop circuit **20** that is operatively coupled to a connection port **30** that allows the stop circuit **20** to be attached to a wiring circuit or harness **40** that is coupled to a safety control system **50** that monitors the operational status of the switch **10**. The safety control system **50** is configured to be coupled to various automated machinery **60** that is part of an automated production line, process, or manufacturing line. As such, the actuation of the emergency stop switch **10** causes the safety control system **50** to responsively stop the operation of the machinery **60** to which it is coupled.

Stop circuit **20** of the emergency safety switch **10** includes electrical connection terminals **100**, **110**, **120**, **130**, **140**, and **150**. Coupled between terminals **100** and **140** are a series of coupled light elements **160** and light switches **170**, which form a first path. It should be appreciated that the light element **160** may comprise any suitable illumination element, such as an LED (light emitting diode), or incandescent light for example. Coupled between terminals **110** and **130** is a control switch **200**, which forms a second path, and coupled between terminals **120** and **150** is a control switch **210**, which forms a third path. In one aspect, the light and control switches **170**, **200**, **210** may comprise push-button type switches that are configured to be moved between an ON and OFF position or state, such that the light switch **170** is nor-

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mally in an OFF state or open position, while the control switches **200**, **210** are normally in an ON state or closed position. In addition, the movement of the light switch **170** and control switches **200**, **210** from their normal resting position or state is controlled by a main switch or actuator **250** that is operatively attached to the switches **170**, **200**, **210**. It should be appreciated that the actuator **250** and switches **170**, **200**, **210** are configured as maintained switches that are configured to remain in either a normal resting state or an active state, and are only moved from one state or the other upon the manual actuation of the actuator **250** by the user. For example, when the actuator **250** is configured as a push button and is depressed from its normal resting state, the actuator **250** and the switches **170**, **200**, **210** are moved to an active state where they remain until the actuator **250** is manually actuated again by the user, such as by pulling or twisting the actuator **250**, which results in the actuator and switches **170**, **200**, **210** returning to their normal resting state.

As such, during operation of the emergency safety switch **10**, when the actuator **250** is depressed by the user's hand, the light switch **170** and control switches **200**, **210** are moved to their active position or state where they maintained. As a result, the light switch **170** is moved to an ON or closed position, and the control switches **200**, **210** are moved to an OFF or open position. If it is desired to return the actuator **250** and switches **170**, **200**, **210** to the normal resting state then the actuator **250** is manually moved back to its normal resting state by pulling or twisting the actuator **250** backward. As a result, the actuator **250** and switches **170**, **200**, **210** are moved back to their normal resting state where they are maintained.

The connection port **30** includes interfaces **300** and **310** that allow the emergency safety switch **10** to be readily coupled in-line or in series with the wiring harness or circuit **40**. In one aspect, the connection interfaces **300** and **310** may be configured as threaded or quick-disconnect connectors that are compatible with counterpart connectors provided by the wiring harness or circuit **40**. Each interface **300** and **310** includes four interface terminals **320A-D** and **330A-D**, respectively. Terminals **320A** and **320C** of interface **300** are respectively coupled to terminal **330A** and terminal **330C** of interface **310** by respective wires or bridge lines **350** and **352**. Furthermore, interface terminals **320A** and **330A** of interfaces **300** and **310** are coupled to terminal **100** of the stop circuit **20** via wire **354**, while interface terminals **320C** and **330C** of interfaces **300** and **310** are coupled to terminal **140** via wire **356**. In addition, interface terminals **320B** and **320D** of interface **300** are respectively coupled to terminals **120** and **110** of the stop circuit **20**, while interface terminals **330B** and **330D** of interface **310** are respectively coupled to terminals **150** and **130** of the stop circuit **20**. It should also be appreciated that the stop circuit **20** and connection port **30** may be carried by any suitable housing.

The emergency safety switch **10** is configured to be coupled in-line with the wiring circuit or harness **40**, which includes four conductive lines or wires: a power wire **400**; a safety control A wire or line **410**; a ground (GND) wire **420**; and a safety control B wire or line **430**. In one aspect, the power and ground (GND) wires or lines **400** and **420** may be coupled to any suitable power source, including a 24 VDC power source for example. The safety control wire A **410** and safety control wire B **430** are configured to communicate with the safety control system **50** that is configured to be interfaced with various machinery **60** that is part of the production line being monitored.

Thus, to place the emergency safety switch **10** into operation, the connection port **30** is attached in-line or in series with each end of the wiring circuit **40**, denoted as **40A** and **40B**,

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provided by the safety control system **50**, such that interface **300** is attached to end **40A** of the wiring **40** and interface **310** is attached to end **40B** of the wiring **40**. Once the emergency stop switch **10** is connected to the safety control system **50**, the light switch **170** is maintained in a normally open or OFF position, while the control switches **210** and **220** are both maintained in a normally closed or ON position. Upon depressing or otherwise actuating the main switch **250** by the user to identify an adverse event, such as the malfunction of the machinery **60**, the light and control switches **170**, **200**, **210** are placed in their active position, such that the light switch **170** is closed and the control switches **200**, **210** are opened. As a result, the light element **160** is illuminated to indicate that the emergency safety switch **10** was actuated, while the safety A and safety B control lines **410** and **430** of the wiring circuit **40** are placed in an open circuit state. Specifically, the safety control system **50** interprets the open circuit state of the control lines **410**, **430** as an adverse event, and correspondingly takes corrective action by shutting down or terminating the operation of the necessary machinery **60** to prevent the furtherance of damage to such machines and/or to prevent injury to persons in the vicinity.

It will, therefore, be appreciated that one advantage of one or more embodiments of the present invention is that an emergency safety switch that provides a connection port is configured to be readily and quickly attached to a wiring circuit provided by a safety control system. Another advantage of the present invention is that the emergency safety switch is configured to be connected to emergency control lines provided by the wiring circuit of a safety control system used to shut down automated machinery in the event of an adverse event. Still another advantage of the present invention is that the emergency safety switch provides a light element to identify that the emergency safety switch has been actuated.

Thus, it can be seen that the objects of the present invention have been satisfied by the structure and its method for use presented above.

What is claimed is:

1. An emergency safety switch configured to be coupled to a wiring circuit of a safety control system used to terminate the operation of one or more automated machines coupled thereto, the emergency safety switch comprising:

- a first path having a first control switch;
- a second path having a second control switch;
- a main switch in operative communication with said first and second control switches; and
- a first and second connection interface adapted to be coupled in series with the wiring circuit of the safety control system, each said connection interface having at least four terminals, such that said first and third terminals of each said first and second connection interfaces are coupled together by respective first and second bridge lines, such that said first path is coupled between said fourth terminals of said first and second connection interfaces, and said second path is coupled between said second terminals of said first and second connection interfaces, a third path including a light switch in series with a light, said light switch in operative communication with said main switch, said third path being coupled between the first bridge line and said second bridge line, wherein when said main switch is actuated, said light switch is moved from a normally open state to a closed state;

wherein when said main switch is actuated, said control switches are moved from a normally closed state to an open state.

2. The emergency safety switch of claim 1, wherein said light comprises a light emitting diode (LED).

3. The emergency safety switch of claim 1, wherein said first, second, and third paths, said main switch, and said first and second connection interfaces are carried by a housing. 5

4. The emergency safety switch of claim 1, wherein said first and second connection interfaces each include a quick-disconnect port.

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